Bulletin No. 61. January 22, 1923.

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF INTERNAL AFFAIRS
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MAGNETITE IN PENNSYLVANIA

By

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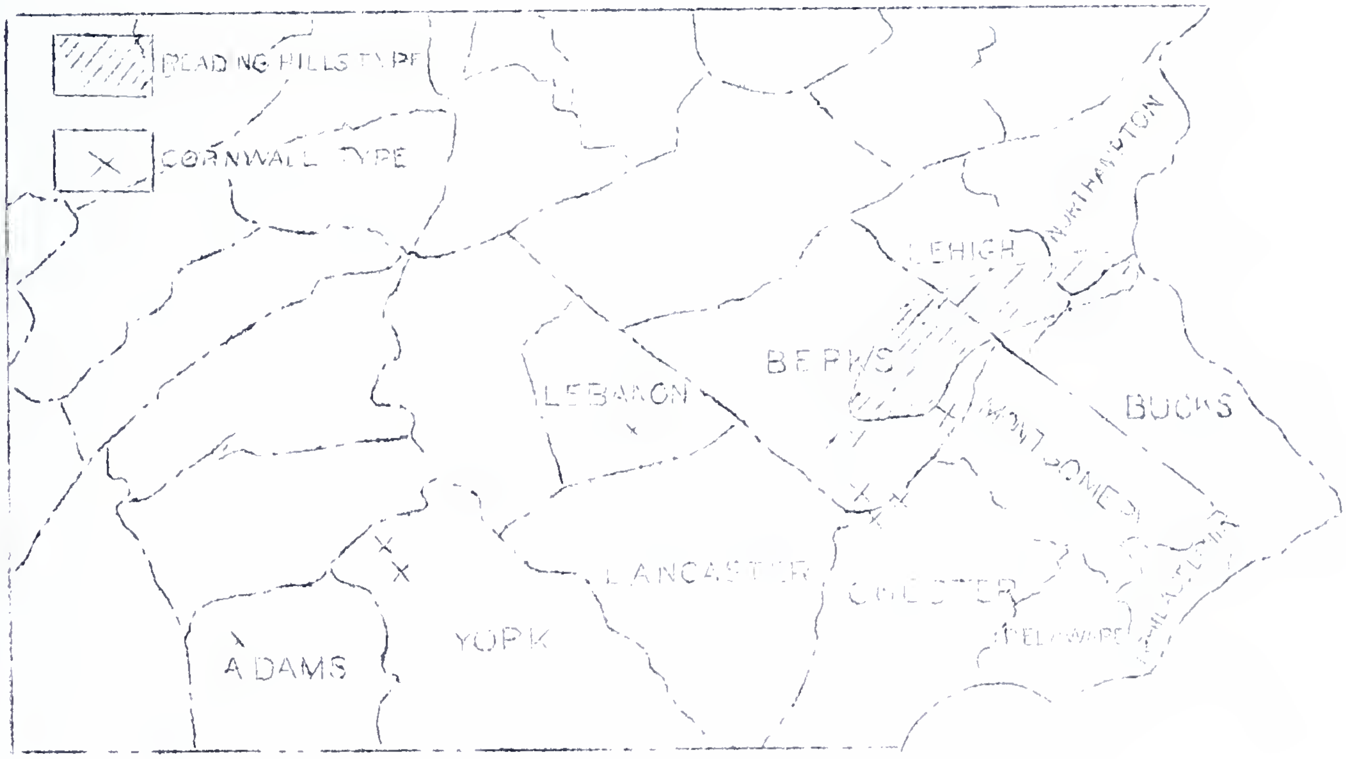
Importance as an ore: In Pennsylvania the yearly production of magnetite is greater than that of all other iron ores combined. Each year since 1912 magnetite has constituted over 90 per cent of all the



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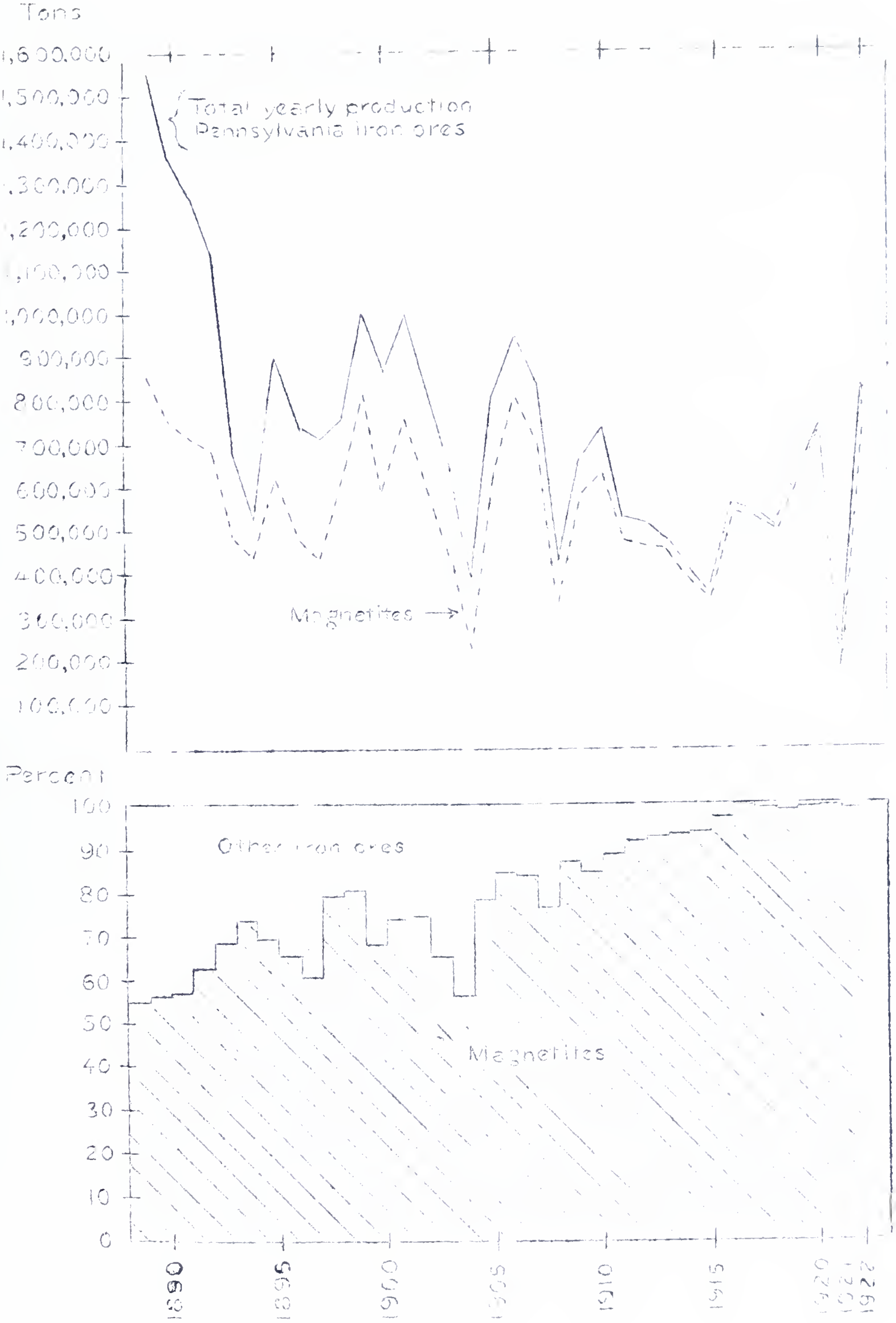

Relation of yearly production of magnetite to total yearly production of all iron ores in Pennsylvania, 1889-1922.

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iron ore mined in Pennsylvania; and since 1889 it has never been less than 55 per cent. Magnetite production has varied from less than 300,000 tons to more than 800,000 tons per year, depending on market conditions. Details of these variations are shown in the diagrams on the preceding page, the data for which were taken from Mineral Resources of the United States, from the Bureau of Statistics and Information, Department of Internal Affairs, Commonwealth of Pennsylvania, and from other sources.

Economic Conditions: Many of the magnetite ore bodies are massive and contain from 100,000 to 1,000,000 or more tons of ore. Usually, excessive water is not encountered in mining operations. Because of the great difference in specific gravity between magnetite and the gangue minerals, and of the peculiar magnetic properties of magnetite, an ore of poor quality can readily be beneficiated and a separation of magnetite from other heavy minerals can be made. Phosphorus, if present in a gangue mineral, can be greatly reduced and sometimes eliminated. The sulphur can be almost entirely removed by proper sintering, leaving a product which somewhat resembles coke in appearance and is hard, tough, and porous. By proper control of the processes various grades of product can be made. For these reasons magnetite forms a very important class of Pennsylvania iron ores.

Although mineralogically alike, the ore bodies can be divided into two groups or types by their difference in mode of occurrence.

Reading Hills type: Geographically, magnetite ore has been found at various places in the Durham and Reading Hills, from Reading northeastward in Berks, Lehigh, Northampton and Bucks counties to the Delaware. The large workings in this area are those of the Absalom Beitler mine near Fredericksville, the mines at Rittenhouse Gap, (near Siesholtzville) those just north at Vera Cruz Station, and those near Durham Furnace (near Riegelsville). Others of this area are at Shimersville; 1½ miles southeast of Bethlehem; near Spring Valley, Barto, near Shanesville, and near Pricetown.

These occurrences resemble each other in that the magnetite is in the pre-Cambrian gneisses which form the hills. The magnetite is both massive and disseminated. In some cases the massive forms end abruptly, as if faulted; in other places the ore becomes leaner by greater dispersion of the magnetite as grains in the gneiss. Not infrequently parallel "veins" or "beds" are found, and some veins or beds appear to branch. Because of these resemblances the deposits are grouped together and referred to as the Reading Hills type.

All of the rich ore of this type exposed at the surface was mined many years ago. With depth, mining became more difficult and expensive, and finally the mines were abandoned. Since the abandonment of these mines great progress has been made in the arts of mining and concentration (ore-beneficiation) and because of these advances some deposits which formerly were unprofitable are now regarded as ore or possible ore.

Cornwall Type: Deposits of another type occur at Boyertown, Fritz Island, Fritztown, in southern Berks and northern Chester counties,

(mined at St. Peters) at Cornwall (Lebanon County), near Dillsburg (York County), and near Cashtown (Adams County). The distinguishing trait of these deposits is the presence of limestone (or limey shale) and diabase (an igneous rock). Because the largest producer in this group is at Cornwall, these deposits are known as the Cornwall type. Strangely, the neighboring states do not contain similar deposits.

Although deposits of the Cornwall type were formed under similar geologic conditions, the ore-bodies are not entirely similar. The ore may be firm, hard, and massive, it may be crystalline, or it may be soft and earthy. The sulphur content of these ores is high, owing to the presence of pyrite. This does not now form the obstacle it once did, however, for such sulphur can easily be removed by mechanical devices and by sintering. The small quantity of copper accompanying ores of the Cornwall type can be partially recovered, thus forming a valuable by-product.

The following analyses from Mineral Resources of the United States and from reports of the Second Geological Survey of Pennsylvania show the composition of both types of these ores:

Analyses of magnetite in Pennsylvania.

	1.	2.	3.	4.	5.	6.
Iron	47.025	63.750	42.700	64.900	57.050	51.450
Manganese	---	0.936	7.997	0.158	0.064	0.072
Copper	---	---	---	0.005	0.447	0.559
Sulphur	---	0.224	0.020	0.071	2.531	2.459
Phosphorus	0.06	0.040	0.135	0.014	0.007	0.010
Alumina	2.80	3.750	3.411	0.324	1.594	1.080
Lime	1.40	0.090	0.040	1.010	2.740	2.600
Magnesia	2.81	0.400	1.502	1.131	3.942	6.652
Silica	12.90	---	---	3.980	8.650	12.270
Insoluble Residue	---	1.010	14.305	---	---	---
Titanic Acid	---	3.930	---	---	---	---

	7.	8.	9.	10.	11.	12.
Iron	51.050	48.800	46.400	41.900	42.75	44.07
Manganese	0.115	0.057	0.238	0.194	---	---
Copper	0.295	0.599	0.066	0.319	---	---
Sulphur	3.271	1.807	0.050	0.428	0.59	1.56
Phosphorus	0.010	0.018	0.025	0.019	0.01	0.021
Alumina	1.298	2.315	7.815	4.970)		
Lime	2.340	4.530	2.550	2.810)	11.45	
Magnesia	6.616	5.531	2.738	7.437)		
Silica	11.560	12.940	18.040	20.910)	22.10	8.48

	13.	14.	15.	16.	17.	18.
Iron	46.57	59.60	43.00	38.05	43.40	34.55
Manganese	---	0.23	---	0.42	0.01	0.21
Copper	---	0.12	0.59	0.56	0.01	0.17
Sulphur	1.38	1.94	0.53	1.14	0.43	1.64
Phosphorus	0.020	0.06	0.02	0.04	0.09	0.03
Alumina Lime Magnesia	---	19.18	13.86	19.77	18.90	22.38
Silica	11.10	20.20	14.02	16.13	11.13	21.21

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1. Siesholtzville, Berks County, Mineral Resources of the United States, 1886

2. Beitler's mine, Rockland Twp., Berks Co., Second Pennsylvania Geological Survey, MM p. 229

3. Clymer Iron Co's. ore on Cornman's farm; 2½ mi. NE of Pricetown, Second Pennsylvania Geological Survey, MM p. 229

4. Cornwall, 115 pieces of Nigger-head ore from Middle hill

5. Cornwall, "No. 3 ore" from east face of Middle hill

6. Cornwall, fine or soft No. 3 ore from west cut, north side, Middle hill

7. Cornwall, fine or soft No. 3 ore from west cut, south side, Middle hill

8. Cornwall, "No. 1 ore" from east face of Middle hill

9. Cornwall; Fix or Wash ore, near engine house, base of Big hill; sample, 25 pounds

10. Cornwall, "No. 1 light ore" from west cut, south face, Middle hill

Samples 4-10 were dried at 212° F. + before analysis.

(Analyses 4-10 from Second Penna. Survey, Ann. Rpt. 1885, pp 552-553)

11. A. Underwood's mine, Dillsburg.

12. Jones mine, Joanna, Berks County, Mineral Resources of the United States, 1887

13. " " " " " " "

14. Wheatfield mine, Berks County

15. Island mine, Reading, slope No. 1.

16. 25 pounds from Island mine, Reading.

17. Black ore, 163 pieces, from Warwick mine, Boyertown, Berks County.

18. "Blue ore," 20 pounds, from Phoenix mines, Boyertown.

(Analyses 11, 14-18 from Second Pennsylvania Survey Annual Report 1885, p 537).

Discoveries and Magnetic Instruments: Those bodies of magnetite which showed at the surface were known to the early settlers. The Cornwall deposits were known in 1732 (and, incidentally, these are the oldest mines which have been continuously worked in America). The deposits at Boyertown were discovered in digging the foundation for a house, and by similar accidents other deposits were developed. The use of the dip-needle was tried at various places with varying success. To some deposits (such as those at Dillsburg) the dip-needle was particularly suited, and several discoveries are reported as being due to its use. However, compared to instruments such as the magnetometer which have been devised in recent years, the dip-needle is a crude and unreliable instrument which exhibits many apparent eccentricities. The magnetometer and similar instruments are very sensitive to magnetic forces and have been used with marked success in many places. So sensitive are these instruments that they are perceptably affected by the electromagnetic storms on the sun. The correct use of these instruments therefore demands simultaneous readings at "control" stations.

It is believed that many square miles in southeastern Pennsylvania afford favorable geological conditions for the formation of magnetite deposits. Such as may exist have not yet been discovered because they do not outcrop or are not very close to the surface. This Survey has conceived the idea of making a detailed magnetometric survey of promising areas for the purpose of determining as accurately as possible the presence or absence of large magnetite ore-bodies. The cooperation of the U. S. Coast and Geodetic Survey has been assured in such work. The U. S. Coast and Geodetic Survey has established permanent stations which it would re-occupy during such a survey.

The proposed investigation would bring results of great value to the State, to the industry, to the communities near which and to the owners of the land under which the deposits occur. However, work along this line must be deferred for the present because of lack of funds.